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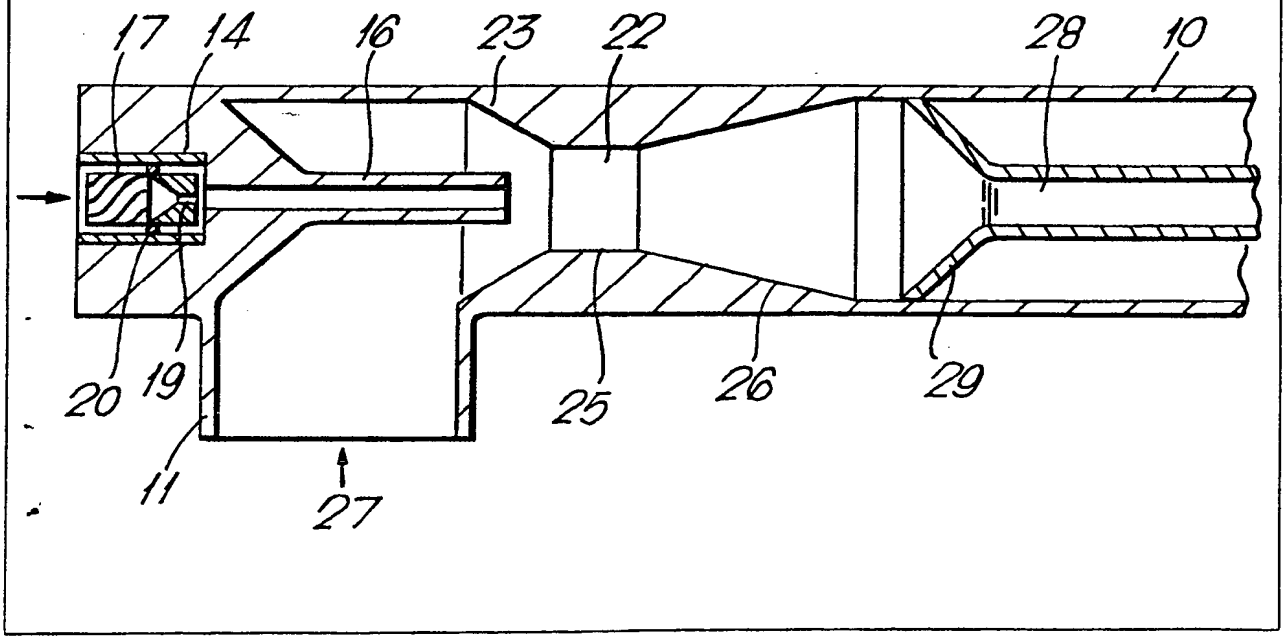
(12) UK Patent Application (19) GB (11) 2 076 672 A

(21) Application No 8005391
(22) Date of filing 18 Feb 1980
(43) Application published
9 Dec 1981
(51) INT CL³
B01F 5/04
(52) Domestic classification
B1C 14 19A3 D2C
(56) Documents cited
GB 1500317
GB 1338708
GB 1235727
GB 878949
GB 777139
(58) Field of search
B1C
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(54) **Making foam**

(57) In the production of foam a surfactant-containing liquor is passed through a swirling device 17 in a high pressure nozzle 19 and through an injector tube 16 into a venturi 22 where it causes air to be drawn into the apparatus. The air/liquor mixture then passes along a mixing tube 28 to the foam outlet. By specific selection of dimensions of the various components of the apparatus, a foam with an air to liquor ratio of from 9:1 to 26:1 can be produced from a surfactant-containing liquor supply at 600 to 2,200 p.s.i. The foam is used for cleaning hard surfaces particularly in food processing sites.

Fig. 1.



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Fig.1.

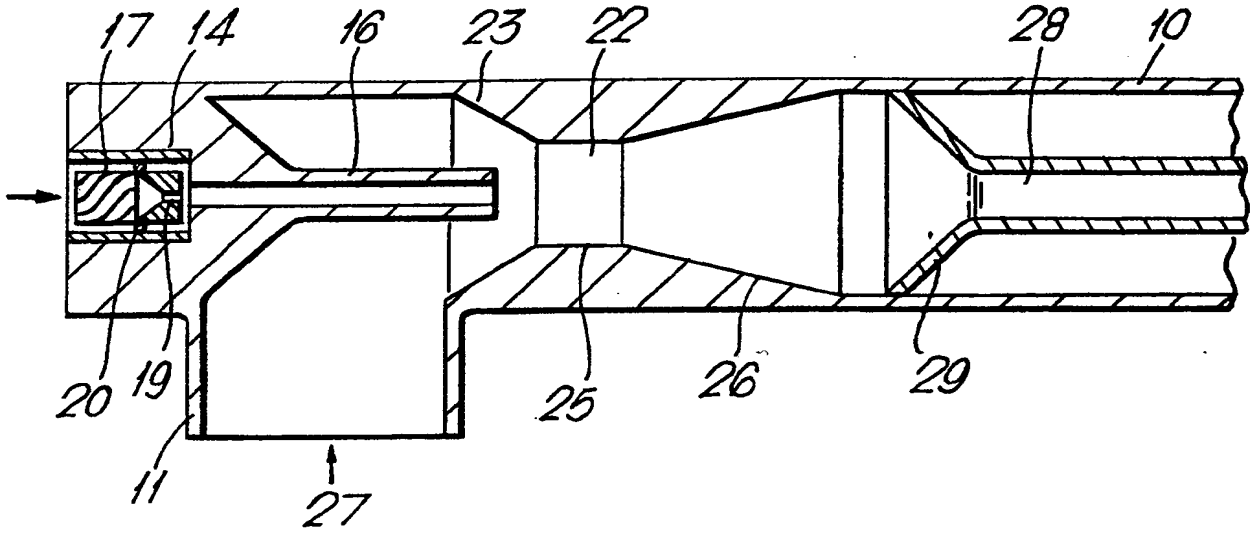
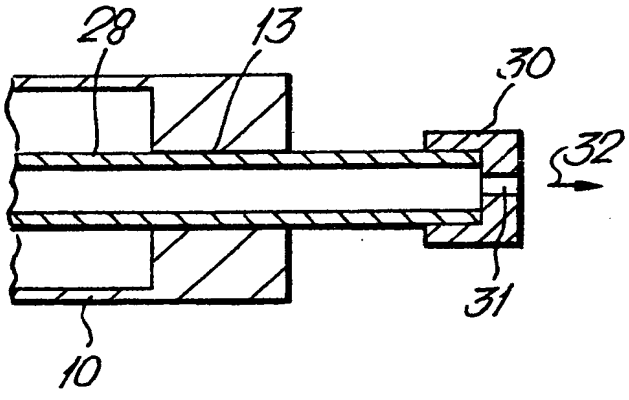


Fig.2.



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SPECIFICATION

Foam producing apparatus

This invention relates to a foam producing apparatus, in particular, but not exclusively to a foam producing apparatus for the power cleaning of hard surfaces in industrial food processing sites, for example, of walls, floors and operating equipment.

Foam producing apparatus are known in which a detergent containing liquid is mixed with air to produce a foam which is discharged from the apparatus under pressure. It is desirable for the apparatus to produce a foam containing little or no free liquid, and to this end it is desirable to use an air to liquid ratio in excess of about 5:1. Known foam producing apparatus to date either fail to produce a foam with an air to liquor ratio in excess of 5:1, or do so in a manner which generates a back pressure in the air inlet of the apparatus so that it becomes necessary to use a device for producing compressed air for use with the apparatus.

It is an object of the invention to provide a foam producing apparatus which produces a foam with a high air to liquor ratio while creating little or no back pressure in the air supply.

Thus, according to the invention there is provided an apparatus for producing foam from a surfactant-containing liquor by mixing the liquor with air, said apparatus comprising

(i) a venturi;

(ii) liquor inlet means upstream of said venturi, said inlet means including means for subjecting a swirling motion to said liquor before it enters the venturi;

(iii) air inlet means upstream of said venturi;

(iv) a mixing tube downstream of said venturi and in communication therewith; and

(v) a foam outlet at the down stream end of said mixing tube.

The apparatus will normally be used with a device for producing a surfactant-containing liquor at a pressure of 500 to 2,500 p.s.i. and at a flow rate between 5 and 25 litres/minute. Preferably, the ratio of the volume of the mixing tube to the volume of the venturi throat is in excess of 10:1. Advantageously, the diameter of the mixing tube is less than the diameter of the venturi throat.

Ideally, the liquor inlet means discharges the liquor into the venturi downstream of the air inlet means. This can be achieved when the liquor inlet means includes an injection tube opening directly into the venturi.

The air inlet means may be constituted by one or more air inlet tubes or by air inlet apertures opening into the apparatus. A device may also be included to control the quantity of air entering the apparatus, such as an adjustable valve or a perforated cup.

The invention will now be described, purely by way of example, with reference to an embodiment thereof shown in the accompanying drawings in which

Figure 1 is a longitudinal cross section of the rear end of a foam producing apparatus according to the invention; and

Figure 2 is a longitudinal cross section of the front end of the same apparatus.

The apparatus shown in the drawings comprises a cylindrical tube 10 towards the rear end of which there is provided a radially extending air inlet tube 11. Each end of the tube 10 is closed with the exception of an axial boring 13 at the front end and an axial boring 14 at the rear end, the latter consisting of a relatively wide portion immediately at the rear of the tube 10 and a relatively narrow portion to the front thereof defined by an injection tube 16 which extends into the hollow space of the tube 10 beyond the air inlet 11. In the relatively wide portion of the axial boring 14, there is inserted a swirler and a nozzle 19, the annular space between these components and the wall of the boring 14 being sealed by an O-ring 20. The diameter of the nozzle 19 is less than that of the injection tube 16.

Beyond the air inlet 11 and the injector tube 16 there is positioned a venturi 22 defined by an inwardly conically tapering wall 23, a cylindrical wall 25 and an outwardly conically tapering wall 26. The diameter of the venturi throat defined by the cylindrical wall 25 is greater than the diameter of the injector tube 16. Substantially immediately beyond the venturi 22 is a mixing tube 28 which is concentric with the tube 10. The rear end of the mixing tube is secured to the tube 10 by an inwardly conically tapering wall 29 or by a sleeve (not shown) fitted around the mixing tube 28. The volume between the outwardly conically tapering wall 26 and the mixing tube tapering wall 29 is small so that expansion of the foam before entering the mixing tube is kept to a minimum. The mixing tube 28 passes through the boring 13 at the front end of the tube 10, and projects therebeyond. The front end of the mixing tube 28 is provided with an end cap 30.

The various components of the apparatus can be integral with the tube 10 or may all be formed by separate parts secured together by conventional engineering methods, or by any combination thereof.

The apparatus described operates as follows. A mixture of water and a surfactant and/or other cleaning materials, enters the apparatus under pressure as indicated by the arrow 31. This liquid passes through the swirler 17 where a rotational component of motion is added to its axial component of motion. The swirling liquid now passes through the nozzle 19 into the injector tube 16. The injector tube 16 is of such a length that the jet of swirling liquid emanating therefrom is substantially cylindrical, i.e. it has very little outward divergenc .

As the liquid jet passes through the venturi 22, air becomes entrained therein, creating a negative

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pressure resulting in the sucking of air into the apparatus through the air inlet 11 as shown by the arrow 27. The mixture of air and swirling liquid now enters the mixing tube 28. The small divergence of the jet of liquid passing through the venturi 22 means that very little liquid strikes the surface of the inwardly conically tapering wall 29, so that very little back pressure is generated.

In the mixing tube 28, the air and liquid become thoroughly mixed into a foam. The end cap 30 at the front end of the mixing tube 28 has an axial bore 31 therethrough having a rectangular or elliptical cross section and a cross-sectional area approximately the same as that of the mixing tube 28 so that very little back pressure is generated at this point but sufficiently different to spread the foam jet as it exits the apparatus as shown by the arrow 32.

The performance of the apparatus in practice depends, to a large extent, on the dimensions and in particular on the relative dimensions, of the components of the apparatus. For example the mixing tube 28 must have a volume which is in excess of ten times the volume of the throat portion of the venturi as defined by the cylindrical wall 25. The diameter of the mixing tube 28 must be less than the diameter of the throat portion of the venturi. Suitable apparatus according to the invention have the following dimensions and are operated in accordance with the following parameters:

Nozzle diameter	1.3 to 1.7 mm
Length of injector tube	75.0 mm
Length of venturi throat	17.0 mm
Diameter of venturi throat	17.0 mm
Length of mixing tube	65.0 mm
Diameter of mixing tube (28)	10.0 to 13.0 mm
Radial dimensions of end cap boring (31)	20.0 mm x 6.0 mm
Liquid pressure	600 to 2,000 psi
Liquid composition	0.2 to 2.0% by weight surfactant; 0.2 to 2.0% by weight alkali balance water
Temperature of liquid	5 to 90°C
Air to liquor ratio of foam produced	9:1 to 26:1
Liquid consumption rate of an apparatus	10 to 14 litres/minute
Foam residence time	5 to 20 minutes depending on air:liquor ratio and surface roughness

The air to liquor ratio of the foam produced can be altered by varying (a) the nozzle diameter, (b) the air inlet diameter, (c) the venturi throat diameter, (d) the mixing tube diameter, (e) the injector tube diameter and/or (f) the distance between the nozzle and the venturi throat.

CLAIMS

1. An apparatus for producing foam from a surfactant-containing liquor by mixing the liquor with air, said apparatus comprising:

(i) a venturi;

(ii) liquor inlet means upstream of said venturi, said inlet means including means for subjecting a swirling motion to said liquor before it enters the venturi;

(iii) air inlet means upstream of said venturi;

(iv) a mixing tube downstream of said venturi and in communication therewith; and

(v) a foam outlet at the downstream end of said mixing tube.

2. An apparatus as claimed in Claim 1, wherein the ratio of the volume of the mixing tube to the volume of the venturi throat is in excess of 10:1.

3. An apparatus as claimed in Claim 1 or 2, wherein the liquor inlet means includes a high pressure nozzle and an injector tube.

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4. An apparatus as claimed in Claim 3 wherein the diameter of the mixing tub is less than the diameter of the venturi throat and the diameter of the venturi throat is greater than the diameter of the high pressure nozzle and of the injector tube.

5. An apparatus as claimed in any one of Claims 1 to 4, wherein the liquor inlet means discharges the liquor into the venturi downstream of the air inlet means.

6. An apparatus substantially as hereinbefore described, with reference to, and as illustrated in, the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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